REMARKS

Claims 1, 4-5 and 8 have been rejected under 35 USC 103(a) as unpatentable over Yokota; and claims 2 and 6 have been rejected under 35 USC 103(a) as unpatentable over Yokota in view of Fuerhoff. The rejections are respectfully traversed.

The present invention resolves a specific problem caused when a high resistivity silicon single crystal having a resistivity in the range of 100 to 2000 Ωcm is pulled up with a CZ method. That is, it has been found by the present inventors that an effect of an impurity concentration on resistivity becomes more conspicuous with an increase in resistivity, and thus, a slight difference in the impurity concentration in the silicon single crystal leads to a great fluctuation in resistivity. The invention seeks to grow a high resistivity silicon single crystal free from fluctuation in resistivity.

According to the present invention, silicon raw materials having an impurity concentration controlled to a certain range are used. Specifically, the impurity concentration in the silicon raw material is controlled in the range of -5 to 50 ppta in a case of a CZ method and in the range of -25 to 20 ppta in a case of MCZ method in terms of (a donor concentration-an acceptor concentration).

The present invention is not only uses silicon raw materials having a low impurity concentration, but also by selecting and using raw materials whose donor concentration and acceptor concentration satisfy specific conditions. By using this technique, the present invention has an effect that high resistivity silicon single crystals having almost the same resistivity due to suppression of a fluctuation in resistivity around a target value can be stably manufactured.

Yokota, on the other hand, discloses preventing generation of staking faults by thermal oxidation from a surface of a silicon wafer. Yokota seeks to grow a silicon single crystal having minimized generation of oxygen-induced stacking faults. In order to accomplish the aforementioned, an impurity concentration in a silicon single crystal pulled up is adjusted to not more than a constant value. Specifically, after pulling of the single crystal silicon, impurity concentrations in a crucible residue are measured, and individual concentrations of Cu, Fe, Ni and

Cr in the residue are adjusted to not more than 0.1 ppta, and the total content thereof is adjusted to not more than 0.4 ppta; preferably individual concentrations of Cu, Fe, Ni, Cr, Ti and Mn are adjusted to not more than 0.1 ppta and the total amount thereof is adjusted to not more than 0.6 ppta. That is, Yokota discloses that the impurity concentrations in the crucible residue are measured after pulling up, and when the impurity concentrations are extremely low, the silicon single crystal having minimized general of oxygen-induced stacking faults can be obtained.

The patentable distinctions between the claimed invention and Yokota follows:

Yokota discloses growing the silicon single crystal having minimized generation of oxygen-induced stacking faults, but not at growing the high resistivity silicon single crystal, as required by the present invention. Accordingly, Yokota does not disclose the problem caused when the high resistivity silicon single crystal is pulled up with the CZ method, namely, the great fluctuation in resistivity caused by the slight difference in the impurity concentration in the silicon single crystal.

Rather, Yokota teaches that when the concentrations of the specific impurities (Cu, Fe, Ni, Cr, and the like) in the silicon single crystal pulled up are low, the generation of the oxygen-induced stacking faults can be inhibited, but it does not describe specific methods for reducing the impurities (for example, the use of the silicon raw materials having low impurity concentrations, and the use of the silicon raw materials having the impurity concentrations controlled to the specific ranges). Naturally, the reference does not disclose the relationship between the donor concentration and the acceptor concentration in the silicon raw material.

On the other hand, according to the present invention, the raw materials whose donor concentration and acceptor concentration satisfy the specific conditions are used, but it is not necessary to lower the impurity concentrations in the silicon raw material. The donor (n-type) and the acceptor (p-type) are dopants but are not metal impurities. It should be appreciated that even if the absolute values of the impurity concentrations in the silicon raw material are large, (a donor concentration-an acceptor concentration) can be reduced. Further, since impurities from a crucible

may dissolve in a molten material when the CZ method is applied, the impurity concentrations of the silicon raw material are not necessary consistent with the impurity concentrations of the single crystal pulled up. The parameter (a donor concentration-an acceptor concentration) in the silicon raw material defined in the present invention is a value obtained taking into consideration the difference between the CZ method and the MCZ method in amounts of impurities from a crucible. The cited reference does not disclose this point at all.

In view of these patentable distinctions, the metal impurity concentrations of the silicon single crystal pulled up in Yokota, which is a produce, are just reduced. This is different from the instant invention in which (a donor concentration-an acceptor concentration) the silicon raw material is reduced. As a result, according to the applied reference, the silicon single crystal having minimized generation of oxygen-induced stacking faults is obtained. In the present invention, on the other hand, the high resistivity silicon single crystal having almost the same resistivity due to suppression of a fluctuation in resistivity around a target value can be stably manufactured.

Since the recited methods are not disclosed be the applied prior art, claims 1 and 5 are patentable. Claims 2 to 4 and claims 6 to 8, which depend on claims 1 and 5, respectively, are similarly patentable.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue. If it is determined that a telephone conference would expedite the prosecution of this application, the Examiner is invited to telephone the undersigned at the number given below.

In the event the U.S. Patent and Trademark office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to Deposit Account No. 03-1952 referencing docket no.

474082002600. However, the Commissioner is not authorized to charge the cost of the issue fee to the Deposit Account.

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Respectfully submitted,

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